December 8, 2022

Ann E. Misback
Attention: Comments—Docket No. OP-1793
Board of Governors of the Federal Reserve System
20th Street and Constitution Avenue NW
Washington, D.C. 20551

Re: Request for Comment on Principles for Climate-Related Financial Risk Management for Large Financial Institutions

To Whom It May Concern,

We are Duke University undergraduate students with interdisciplinary backgrounds in economics, public policy, math, and environmental science. Climate change and the energy transition are among the greatest challenges our generation will face. We believe financial regulators have a role to play in ensuring that the financial system is resilient to the economic consequences of a changing climate. In this letter, we recommend higher capital requirements for banks who provide loans to oil and gas companies or otherwise hold "dirty" assets on their balance sheets.

We have a genuine concern in the level of financial risk banks have assumed by investing in greenhouse gas-intensive assets, particularly the world's largest multi-service banks. From 2016 to 2021, JPMorgan Chase, Citigroup, Wells Fargo, and Bank of America alone invested over 1.1 trillion dollars in the fossil fuel industry worldwide, which accounts for over a quarter of all fossil fuel financing since the adoption of the Paris Agreement.[1][2] Yet, the International Energy Agency (IEA) contends that no new oil and gas fields should be developed to stay on pace with our international climate targets.[3] There is a clear, fundamental misalignment between bank financing and greenhouse gas reduction targets. The financial system must be well prepared to withstand a climate-related financial crisis. We have studied the Global Financial Crisis, which highlighted the "too big to fail" risk of global systemically important banks (GSIBs), and understand the harm such a crisis can have on the financial system and the economy. Therefore, we think that capital requirements should be raised for banks with "dirty" assets under two qualifications: (1) capital requirements should be calculated under precise risk models with respect to the time horizon of climate change and the level of bank exposure to carbon-emitting

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[1] "Financing of Fossil Fuel Industry by Banks Worldwide 2016-2021," Rainforest Action Network, https://www.statista.com/statistics/1089798/global-financing-fossil-fuel-sector-bank/.
[2] Rachel Koning Beals, "'Pouring Gasoline on the Fire:' JPMorgan, Citi and Other U.S. Banks Lead Rise in Lending to Oil and Gas: Report," *MarketWatch*, April 2, 2022, https://www.marketwatch.com/story/pouring-gasoline-on-the-fire-jpmorgan-citi-and-other-u-s-banks-lead-rise-in-lending-to-oil-and-gas-report-11648642894.
[3] Simon Jessop, "World's Top Banks Pumped $742 Bln into Fossil Fuels in 2021 - Report," *Reuters*, March 30, 2022, https://www.reuters.com/business/sustainable-business/worlds-top-banks-pumped-742-bln-into-fossil-fuels-2021-report-2022-03-30/.

assets and (2) capital requirements should only be raised for GSIBs because of their interconnectedness with the banking system and importance to the broader economy. In this analysis, a "dirty" asset will refer to any loan or item on a bank's balance sheet with the explicit purpose of supporting the production or supply of fossil fuels (i.e., coal, oil, and gas). This is consistent with the definition provided by John Armour, Professor of Law and Finance at Oxford.[4]

Regulation is designed such that banks must hold more capital to increase their loss-absorbing capacity for riskier assets. However, many policymakers favor higher capital requirements for banks with "dirty" assets because they feel this policy would support the U.S. on a path toward decarbonization.[5] Empirical research suggests this notion is misguided (see "Low Impact" section). Even if it could accelerate decarbonization efforts, we believe in raising capital requirements solely because of their ability to ensure the stability of the financial system. Policymakers are responsible for managing the ecological consequences of climate change; financial regulators, however, must prepare the financial system for any climate-related risks.

Background

Climate change is a serious scientific and financial challenge. Heightened human reliance on carbon-based energy sources has led to the rapid warming of Earth. Carbon emissions have risen a dramatic 51% since the Industrial Revolution, which reflects heightened global reliance on fossil fuels. Human-driven carbon emissions reached their highest levels ever in 2022.[6] Increased carbon emissions result in catastrophic consequences: the Earth's temperature is now increasing at a rate not experienced in over 10,000 years.[7] As such, climate models project Earth's surface temperature to increase by as much as 9.7 degrees Fahrenheit by the end of the century.[8] Climate change is a scientific certainty. Financial regulators concern themselves with these physical effects of climate change insofar as they have very real financial implications.

Financial Risks Associated with Climate Change

[4] John Armour, Luca Enriques, and Thom Wetzer, "Dark and Dirty Assets: Greening Climate-Driven Asset Partitioning," *Oxford Business Law Blog*, https://blogs.law.ox.ac.uk/business-law-blog/blog/2022/06/dark-and-dirty-assets-greening-climate-driven-asset-partitioning.

[5] Lauren Anderson and Francisco Covas, "Climate Risk and Bank Capital Requirements," Bank Policy Institute (2021): 1, https://bpi.com/wp-content/uploads/2021/05/Climate-Risk-and-Bank-Capital-Requirements.pdf.

[6] Zeke Hausfather and Pierre Friedlingstein, "Analysis: Global CO2 emissions from fossil fuels hit record high in 2022," *Carbon Brief*, November 11, 2022. https://www.carbonbrief.org/analysis-global-co2-emissions-from-fossil-fuels-hit-record-high-in-2022/.

[7] "Evidence Climate Change is Real," National Aeronautics and Space Administration, https://climate.nasa.gov/evidence/.

[8] "Climate Change: Global Temperature Projections," National Oceanic and Atmospheric Administration, March 6, 2012, https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature-projections.

Climate change is a significant financial risk. Specifically, climate change poses two distinct types of financial risk: (1) physical risks and (2) transition risks.[9]

Climate-related physical risks refer to the economic and financial losses associated with more frequent and extreme weather phenomena.[10] A warming planet will disrupt land temperatures and ocean currents, directly causing more frequent heat waves, hurricanes, floods, and storms.[11] The globe is already confronting these impacts. In the last two decades, there have been more than 7,000 climate-related extreme weather events, and the amount of extreme floods and tropical storms has more than doubled in this same period.[12]

Such extreme weather events associated with climate change have direct and observable financial implications. Extreme weather events have resulted in close to three trillion dollars in economic losses since the turn of the century.[13] Of course, any weather event will have economic implications; however, these consequences rise to the level of systemic risk when they pose severe damage to entire sectors of the economy. Climate change will intensify these weather-related stressors for a myriad of different economic sectors. Chiefly, the physical risks of climate change will inflict systemic stress onto the agriculture and real estate markets. The agriculture sector will have to confront rising temperatures which inhibit plant growth and reduce crop yield. The National Academy of Sciences predicts that a one-degree Celsius rise in global temperatures would reduce crop yields by up to 7.4%.[14] These physical impacts of climate change are already inflicting severe damage to this industry. Since the 1960s, carbon emissions have reduced agricultural productivity by 21%—the equivalent of the industry losing "7 years of productivity growth."[15]

The physical risks of climate change will also severely jeopardize the real estate market due to rising sea levels. Human activity and carbon emissions have led to the rapid melting of polar ice caps and the subsequent rise of global sea levels: sea levels have risen by an average 8-9 inches in the last 150 years.[16] Rising sea levels will reduce home values and undermine the integrity of the aggregate housing market. By 2100, close to 650,000 homes in the United States will be partially submerged due to rising sea levels, costing the real estate market over 100

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[9] "New Tools Needed to Assess Climate-Related Financial Risk," The White House, November 3, 2021, https://www.whitehouse.gov/cea/written-materials/2021/11/03/new-tools-needed-to-assess-climate-related-financial-risk-2/.

[10] "Climate Change: What Are the Risks to Financial Stability," Bank of England, January 10, 2019, https://www.bankofengland.co.uk/knowledgebank/climate-change-what-are-the-risks-to-financial-stability.

[11] Ben Clarke et al., "Extreme Weather Impacts of Climate Change: An Attribution Perspective," *Environmental Research: Climate* 1, no. 1 (2022): 2, https://iopscience.iop.org/article/10.1088/2752-5295/ac6e7d.

[12] Clarke et al., "Extreme Weather Impacts," 4-5.

[13] "Extreme Weather Events Have Increased Significantly in the Last 20 Years," Yale School of the Environment, October 13, 2020, https://e360.yale.edu/digest/extreme-weather-events-have-increased-significantly-in-the-last-20-years.

[14] Chuang Zhao et al., "Temperature Increase Reduces Global Yields of Major Crops in Four Independent Estimates," *PNAS* 114, no. 35 (2017): 9326, https://doi.org/10.1073/pnas.1701762114.

[15] Ariel Ortiz-Bobea et al., "Anthropogenic Climate Change Has Slowed Global Agricultural Productivity Growth," *Nature Climate Change* 11, no. 4 (2021): 306, https://doi.org/10.1038/s41558-021-01000-1.

[16] "Climate Change: Global Sea Level," National Oceanic and Atmospheric Administration, April 19, 2022, https://www.climate.gov/news-features/understanding-climate/climate-change-global-sea-level.

billion dollars in value.[17] While the physical threat of rising sea levels is concentrated along American coastlines, the associated financial risks will send shockwaves through banks across the country. Reduced home values will put banks at risk of mortgage defaults and jeopardize loans to real estate firms.[18]

Beyond the agriculture and real estate markets, the physical risks of climate change pose severe threats to practically every industry, and the physical risks to specific sectors pose financial implications for banks carrying related assets on their balance sheets. Ultimately, the financial market does not operate in a vacuum. Downturns in other sectors will have direct and material impacts on the banking industry, as illustrated by the 2008 housing crisis. In this way, the physical risks of climate change may pose severe threats to the big banks and thus the stability of the entire financial system.

Beyond the physical risks, "dirty" assets carry enormous transition risks. Transition risks describe the potential consequences that will occur with the inevitable transformation in the global energy portfolio. Developments in green technology, policy changes, and the evolution of investors' preferences will result in more volatility within fossil fuel pricing and supply.[19]

Nation-states' unpredictable policy changes will jeopardize fossil fuels' standing as a legitimate financial investment. Increasingly, politicians have promised to limit if not ban fossil fuels altogether to fight climate change. Each subsequent congress since the turn of the century has expressed more criticism towards fossil fuels and an affinity for alternative energy options (as demonstrated by campaign promises, policy proposals, and campaign donations).[20] While on the 2020 campaign trail, then-candidate Joe Biden promised potential voters that he would "end fossil fuels" completely, indicative of the growing sentiment—particularly on the left—to transform America's energy portfolio.[21] President Biden signed into law the Inflation Reduction Act, which provides 370 billion dollars in clean energy investments.[22] More ambitious climate proposals (like the Green New Deal) present more extreme possibilities of a rapid energy transition.

Such political promises will only become more frequent. In early 2022, almost 70% of Americans think Congress should "prioritize developing alternative energy sources," with almost

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[17] "Sinking Tax Base: Land & Property at Risk from Rising Seas," Climate Central, September 8, 2022, https://assets.ctfassets.net/cxgxgstp8r5d/2KKeTjnqbFelWrZalnPeRR/9a28719038f3a1dddbdd2e8b78b8455b/CC_Sinking_Tax_Base_20220908a.pdf.

[18] "A Bank Evaluates the Impact of Physical Climate Risk to Its Mortgages," S&P Global, https://www.spglobal.com/esg/case-studies/a-bank-evaluates-the-impact-of-physical-climate-risk-to-its-mortgages.

[19] Gregg Gelzinis, "Addressing Climate-Related Financial Risk Through Bank Capital Requirements," *Center for American Progress* (2021): 13.

[20] Steve Cohen, "Preventing a Fossil Fuel Comeback in Congress," Columbia Climate School, October 24, 2022, https://news.climate.columbia.edu/2022/10/24/preventing-a-fossil-fuel-comeback-in-congress/.

[21] Steve Peoples, "In Intimate Moment, Biden Vows to 'End Fossil Fuel,'" *Associated Press*, September 6, 2019, https://apnews.com/article/9dfb1e4c381043bab6fd0fa6dece3974.

[22] "Inflation Reduction Act Guidebook," The White House, https://www.whitehouse.gov/cleanenergy/inflation-reduction-act-guidebook/.

one third demanding a ban on fossil fuels altogether.[23] As the public grows increasingly in favor of an energy transition, there will be political pressure on policymakers to facilitate a change in the energy portfolio via regulation. Economic developments in green energy will also apply pressure to motivate a more rapid transition. The U.S. Government is heavily invested in the fossil fuel industry: the country provides over 20 billion dollars in direct subsidies every year.[24] Innovation is driving green energy to become a cheaper alternative, and as this trend occurs, the United States will have an economic incentive to transform their energy posture. Recent innovation and technological advancements have cut renewable energy costs by 85% in the last decade, and alternative energy is on pace to undercut fossil fuels in all industries in coming years.[25] As the costs of renewable energy continue to fall, the United States will have a heightened incentive to facilitate a national transition to greener energy.

Current and future climate policy poses a transition risk for banks holding "dirty" assets. If fossil fuels become regulated or prohibited on short notice, banks will be left with outstanding loans to firms that have no mechanism to repay them. With threats of transition, fossil fuel firms are already adjusting their long-term projection of asset values. In the midst of the pandemic, oil giant BP marked down their assets' value by over 17 billion dollars based on long-term projections on environmental regulation.[26] The nature of this risk is incredibly uncertain. There is no guarantee if or when such a transition away from fossil fuels will occur. Moreover, the transition from fossil fuels can vary depending on whether the transition is orderly or disorderly. Some models project that more than 20 trillion dollars of assets will be stranded under a rapid energy transition, leaving banks with no means to recoup loans.[27]

These physical and transition risks can carry both microprudential and macroprudential considerations. Microprudential implications describe the financial consequences for an individual entity. This refers to instances where an individual firm is disproportionately exposed to the impacts of climate change (e.g., heat waves cutting a farm's crop yield). Thus, global warming "poses varying degrees of credit, market, liquidity, reputational, and operational risks" to different firms, contingent on their asset exposure.[28] On the other hand, climate change carries macroprudential, or structural implications. Climate change will induce more financial shocks to

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[23] Alec Tyson, Cary Funk, and Brian Kennedy, "Americans Largely Favor U.S. Taking Steps to Become Carbon Neutral by 2050," Pew Research Center, March 1, 2022, https://www.pewresearch.org/science/2022/03/01/americans-largely-favor-u-s-taking-steps-to-become-carbon-neutral-by-2050/.

[24] Savannah Bertrand, "Fact Sheet: Proposals to Reduce Fossil Fuel Subsidies," Environmental and Energy Study Institute, July 23, 2021, https://www.eesi.org/papers/view/fact-sheet-proposals-to-reduce-fossil-fuel-subsidies-2021.

[25] Victoria Masterson, "Renewables Were the World's Cheapest Source of Energy in 2020, New Report Shows," World Economic Forum, July 5, 2021, https://www.weforum.org/agenda/2021/07/renewables-cheapest-energy-source/.

[26] Ron Bousso, "BP Wipes up to $17.5 Billion From Assets with Bleaker Oil Outlook," *Reuters*, June 15, 2020, https://www.reuters.com/article/us-bp-writeoffs/bp-wipes-up-to-17-5-billion-from-assets-with-bleaker-oil-outlook-idUSKBN23M0QA.

[27] Ben Caldecott et al., "Stranded Assets and Renewables: How the Energy Transition Affects the Value of Energy Reserves, Buildings, and Capital Stock," *International Renewable Energy Agency* (2017): 6.

[28] Gelzinis, "Addressing Climate-Related Financial Risk," 3.

the market as a whole during the transition away from "dirty" energy. Nonetheless, climate change rises to the level of "systemic" risk due to the fact that its potential financial consequence could have grave impacts, despite its uncertain probability. As such, climate change is more than a scientific issue—it is a financial one. Banks with "dirty" assets on their balance sheet will be left vulnerable to varying degrees of physical and transition risks associated with climate change.

Financial Exposure to "Dirty" Assets

Despite the financial risks associated with climate change, banks are still heavily exposed to "dirty" assets. In the wake of the pandemic, dozens of large, multinational banks pledged to reach net zero emissions by 2050 as part of Glasgow Financial Alliance for Net Zero (GFANZ).[29] Banks are falling short of this promise. Currently, the 60 largest global banks have an estimated 1.35 trillion dollars of outstanding credit exposure to fossil-fuel related assets.[30] The primary concern around banks' fossil fuel exposure is that banks have failed to react to the physical and transition risks associated with "dirty" assets. Namely, the Paris Agreement represented a clear manifestation of transition risks. With countries pledging to combat climate change, this should have been a clear indicator to banks of the looming regulations and transitions away from fossil fuels. In fact, GFANZ members pledged to accomplish "the objective of the Paris Agreement to limit global temperature increases" by cutting fossil fuel assets from their balance sheets.[31] Nonetheless, banks' behavior has not changed since the adoption of the Paris Agreement. The world's 60 largest banks have already financed fossil fuel entities with over 4.5 trillion dollars since the adoption of the Paris Agreement.[32] Of the 10 largest banks in particular, eight of them actually increased the financing of fossil fuels in the years following this agreement.[33]

Banks are clearly not preparing for and recognizing the transition and physical risks associated with climate change, which leaves them vulnerable to any shock that will inevitably disrupt the market. Even well-diversified banks are still severely exposed to climate change's physical risks. Recent hurricanes and weather events have inflicted damaging losses on banks whose assets have been devalued. For instance, banks and their agriculture-related assets were devastated by the recent hurricane Ian when Florida's multi-billion dollar orange industry was ravaged by harsh winds and flooding.[34] Recent models estimate that the physical risks associated

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[29] "About GFANZ," Glasgow Financial Alliance for Net Zero, https://www.gfanzero.com/about/.

[30] Ford et al., "A Safer Transition for Fossil Banking: Quantifying the Additional Capital Needed to Reflect the Higher Risks of Fossil Fuel Exposures," *Finance Watch* (2022): 4, https://www.finance-watch.org/wp-content/uploads/2022/10/A-safer-transition-for-fossil-banking-Finance-Watch-report.pdf.

[31] "About GFANZ."

[32] "Banking on Climate Chaos: Fossil Fuel Financing Report 2022," Rainforest Action Network, https://www.ran.org/wp-content/uploads/2022/03/BOCC_2022_vSPREAD-1.pdf.

[33] Rainforest Action Network, "Banking on Climate Chaos."

[34] Mavin G. Perez, "'Swampy' Stench Haunts Florida's Orange Farms Devastated by Ian," *Bloomberg*, October 6, 2022, https://www.bloomberg.com/news/articles/2022-10-06/florida-orange-growers-lose-crops-to-hurricane-ian-wind-damage?leadSource=uverify%20wall.

with climate change are already costing major banks more than a quarter trillion dollars annually.[35] Insofar as banks' assets are vulnerable to physical and transition risks, the financial system is vulnerable to future climate-related shocks. Banks' behavior is not aligning with the coming energy transition, and financial institutions need to be prepared when the transition comes.

The Role of Capital Requirements

Capital requirements are an effective tool that regulators use to manage financial risks. They are the regulatory standards for the amount of capital a bank must have in relation to the assets on its balance sheet, and they are usually calculated with respect to the risk-weighted asset holdings of a bank.[36] Capital requirements serve a critical function because they increase banks' loss-absorbing capacity and serve as a buffer when there are shocks to the banking system.[37] The level of minimum capital requirements is the point of contention between proponents and opponents of higher capital standards. The advocates for higher capital requirements argue that they prevent banks from taking on too much leverage and ensure banks' solvency in times of systemic shocks to the banking system.[38] This is why we witnessed a sharp increase in the Common Equity Tier 1 capital ratio in the aftermath of the 2008 financial crisis.[39] Since then, a group of Senators, led by Elizabeth Warren (D-MA) and Sherrod Brown (D-OH), have ardently supported the tougher regulatory framework imposed after the 2008 financial crisis, which includes stricter capital requirements.[40] Another outspoken proponent of higher capital requirements, Federal Reserve Bank of Minneapolis President and CEO Neel Kashkari, believes the purpose of capital requirements is to correct an incentive problem where management teams take on as much risk as possible to maximize the returns of their shareholders.[41] According to him, the private sector cannot address this problem on its own, and that is why strong government regulation is needed to account for this externality.

It is primarily banks who take issue with higher capital requirements. They believe that this regulation increases their cost of lending and decreases the supply of credit, which ultimately

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[35] "New Ceres Report Explores Physical Risks of Climate Change Within the Banking Sector," Ceres, September 8, 2021, https://www.ceres.org/news-center/press-releases/new-ceres-report-explores-physical-risks-climate-change-within-banking.

[36] James Chen, "Capital Requirements: Definition and Examples," https://www.investopedia.com/terms/c/capitalrequirement.asp.

[37] "Definition of Capital in Basel III," Basel Committee on Banking Supervision, https://www.bis.org/fsi/fsisummaries/defcap_b3.pdf.

[38] Anderson and Covas, "Bank Capital Requirements," 1.

[39] "Federal Reserve Supervision and Regulation Report - May 2020," The Federal Reserve, https://www.federalreserve.gov/publications/2020-may-supervision-and-regulation-report-banking-system-conditions.htm.

[40] Colby Smith and James Politi, "Democratic Senators Call for Tougher Capital Requirements for US Banks," *Financial Times*, March 2, 2021, https://www.ft.com/content/44792b80-c331-44e3-b02c-41a151f4cb6c.

[41] "Capital Markets and Banking Regulation," Federal Reserve Bank of Minneapolis, September 18, 2020, https://www.minneapolisfed.org/speeches/2020/capital-markets-and-banking-regulation.

hinders economic growth.[42] Recent findings of the Financial Stability Board (FSB) validate this claim. They concluded each 1 percent increase in the ratio of common equity to risk-weighted assets reduces GDP each year by .12 percent.[43] Opponents also argue that the imposition of higher capital requirements on select banks which lend to carbon-intensive firms is a misuse of the risk-based capital regulatory framework. It would cause lending to shift to the shadow banking sector and in turn decrease the supply of credit available to those who want to invest in the research and development of cleaner sources of energy.[44] This would make it more difficult for financial regulators to monitor the financial stability and risky investments of banks.

Despite the costs of higher capital requirements, we believe the aforementioned financial risks climate change poses a greater threat to our economy. Capital requirements will be an effective tool in mitigating damage, both with regard to physical and transition risks. As extreme weather events become more frequent, higher capital requirements will provide a financial cushion for these increasingly likely physical risks. We recognize that climate change's physical risks are persistent for all asset classes, beyond just "dirty" assets. However, we recommend higher capital requirements exclusively for fossil fuel assets due to their unique exposure to transition risks. Capital requirements will also provide a cushion for banks highly exposed to "dirty" assets whenever (if ever) politicians initiate an energy transition.[45] We do, however, believe that some specific conditions must be met for capital requirements to function effectively.

Our proposal for raising capital requirements for climate-exposed banks relies on two stipulations: (1) capital requirements should be calculated under precise risk models (see "Implementation" section) and (2) capital requirements should only be raised for GSIBs, as they pose a "too big to fail" risk.

Potential Costs of Raising Capital Requirements for "Dirty" Assets

Complex Metrics

One of the primary concerns with raising capital requirements on "dirty" assets is the metrics that would be used to evaluate their risk to the financial system. This stems from the uncertain nature of climate change. While there is a consensus that climate change is a real and anthropogenic phenomenon, the manner in which it unfolds and its precise effects are much harder to predict. For example, precise predictions of how much the sea levels will rise or what specific regions will be hit the hardest rely on several complex, moving variables. Many models

[42] Anderson and Covas, "Bank Capital Requirements," 1.
[43] "The Minneapolis Fed v. The Facts: The Struggle Continues," Bank Policy Institute (2020): 3, https://bpi.com/the-minneapolis-fed-v-the-facts-the-struggle-continues/.
[44] Anderson and Covas, "Bank Capital Requirements," 1.
[45] Gelzinis, "Addressing Climate-Related Financial Risk," 4.

are constructed from looking at past trends and thus have significant limitations.[46] Additionally, accounting for governmental policy that addresses climate change within these models is difficult, if not impossible. In the US, policy can drastically change every four years. Notably, the Trump and Biden administrations took radically different regulatory approaches to the oil and gas industry. While Trump accommodated the industry, Biden banned new drilling on federal land within a few days of taking office.[47] Even if the metrics can correctly estimate US energy policy, the inherent global nature of climate change means models would have to accurately predict policy changes in the rest of the world as well. Some of the world's largest oil and gas reserves lie in unstable parts of the world. The developing Russo-Ukrainian conflict exemplifies how fossil fuel demand and prices are vulnerable to unpredictable geopolitics.[48] Climate change models rely on many moving pieces that can make the exact physical threats of climate change unclear. However, by making banks hold excess capital, we will be better prepared for whatever events do occur. Financial regulation by design does not require certainty; it is constructed to prepare for "extreme but plausible scenarios—outcomes on the tail of the probability distribution."[49] The fact that we do not know precisely what these risks look like is not a reason to forego higher capital requirements.

Furthermore, a concern with the metrics is that the timelines of climate models do not align with the timelines of bank loans. Climate models typically project changes that take place 15-30 years in the future, while the average commercial loan has a maturity closer to two years.[50] Thus, many bank loans will mature before the most severe physical and transition risks actually manifest. It seems unfair to treat all "dirty" assets as equally vulnerable when the riskiness of a short-term loan is substantially less than a longer-term exposure. However, our plan accounts for this by assigning much higher risk to assets with a longer duration.

Another objection to raising capital requirements on "dirty" assets is that risk in the oil and gas industry is not a new phenomenon and the industry has historically weathered unexpected shocks well. It is an industry that runs on a boom-and-bust cycle with extreme highs and lows. There have been times when it looked like the world would run out of oil and gas, and then new technologies such as hydraulic fracturing burst onto the scene. Countries with large oil supplies have also nationalized their oil industry, leading to huge losses for private investors in those countries. The industry is risky, and banks have been assessing this risk for decades. However, it is important to note that climate risk has a very different nature. It is not the typical risk seen in the industry; it is a systematic attempt to shift away from the product entirely. In the

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[46] "Scientific Uncertainty," *Nature Climate Change* 9, no. 797 (2019): 1. https://doi.org/10.1038/s41558-019-0627-1.

[47] Katie Tubb, "Biden's Radical, Anti-Fossil Fuel Energy Policy Costs Americans Dearly," The Heritage Foundation, June 28, 2022, https://www.heritage.org/energy-economics/commentary/bidens-radical-anti-fossil-fuel-energy-policy-costs-americans-dearly.

[48] "Russia-Ukraine War's Effects on the Oil and Gas Industry," GEP, July 5, 2022, https://www.gep.com/blog/mind/russia-ukraine-wars-effects-oil-and-gas-industry.

[49] Gelzinis, "Addressing Climate-Related Financial Risk," 12.

[50] "Weighted-Average Maturity for All Commercial and Industry Loans," Federal Reserve Bank of St. Louis, https://fred.stlouisfed.org/series/EDANQ.

past, there may have been challenges, but people undoubtedly wanted oil and gas. Now, while oil and gas may still be readily available, the government may be actively preventing people from using it. Climate change is an existential threat to the viability of the fossil fuel industry altogether. These severe transition and physical risks have not been priced into the fossil fuel industry. In fact, 93% of institutional fossil fuel investors worry that such transition risks have yet to be internalized.[51] While the fossil fuel industry has historically withstood such unpredictable shocks, the sector has yet to adjust to the systemic threats that climate change poses.

Low Impact

Another concern with raising capital requirements on "dirty" assets is that it could potentially have low impact on the climate while still bringing all of the drawbacks associated with higher capital requirements. There is evidence that raising capital requirements does not significantly change where a company deploys its capital. Furthermore, divestment in companies often does not impact their actions. For example, Stanford GSB cites that "to impact the cost of capital by at least 1% requires that at least 86% of investors choose to hold only clean stocks."[52] Additionally, if raising the capital requirements really did force banks to stop investing in fossil fuel companies, there could be some negative unintended consequences. For example, Exxon would obviously be labeled a fossil fuel company, but they have also undertaken massive projects that make them a leader in the carbon capture and hydrogen energy industries.[53] Pulling funding from those would only weaken the fight against climate change. We attempt to take this into account by using risk metrics that evaluate what the invested funds are being used for rather than just the company they are being given to.

In regard to the larger concern of higher capital requirements' low impact on the climate, it is important to note that our goal is not to solve the issue of climate change. Rather, we aim to preserve financial stability as the effects of climate change are felt and transition costs are realized. Our motivation is financial, not environmental. While higher capital requirements may not help the environment, it may preserve financial stability as environmental changes unfold. Thus, the low impact of these capital requirements is not actually a cost that we believe deserves consideration when deciding whether to implement this plan.

Exacerbation of Financial Risk

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[51] "Climate Change and Artificial Intelligence Seen as Risks to Investment Asset Allocation, Finds New Report by BNY Mellon Investment Management," *Bloomberg*, September 16, 2019, https://www.bloomberg.com/press-releases/2019-09-16/climate-change-and-artificial-intelligence-seen-as-risks-to-investment-asset-allocation-finds-new-report-by-bny-mellon-investm.

[52] Alexander Gelfand, "Why Divestment Doesn't Hurt 'Dirty' Companies," Stanford Business, October 27, 2021, https://www.gsb.stanford.edu/insights/why-divestment-doesnt-hurt-dirty-companies.

[53] Shelby Webb, "Exxon Plans to Build World's Largest Carbon Capture Project in Baytown," *Houston Chronicle*, March 1, 2022, https://www.houstonchronicle.com/business/energy/article/Exxon-plans-to-build-nation-s-largest-carbon-16969014.php.

A final major concern raised in regard to higher capital requirements on fossil fuel assets is that it could actually exacerbate financial risk. There are the general financial risks such as removing capital from the markets which would increase the cost of borrowing. Additionally, there are concerns about the unintended consequence of a "green bubble" that could pose its own substantial risk to the financial system.

The implementation of higher capital requirements would effectively lower the cost of green investments by making them comparatively cheaper to invest in than fossil fuel assets. While this may sound positive, green asset investment has been exponentially increasing. Investment in ESG funds in the US increased by 20 billion dollars from 2020 to 2021, despite the fact that these funds have been underperforming.[54] Some estimates state that on a global level, ESG assets are now one third of all professionally-managed assets, and there are signs that their valuations are becoming stretched.[55] With concerns over a green bubble already palpable, an increased incentive for banks to invest in "green" assets may just exacerbate financial problems. Green investments are already increasing at a much faster rate than oil and gas investments without the federal government enforcing higher capital requirements.

However, the oil and gas industry is still massive. It is estimated that over the last 50 years, the industry has brought in on average 2.8 billion dollars per day in profits.[56] If capital requirements did manage to shift investment away from fossil fuels, there could be some major financial costs. A sudden shift away from fossil fuels could cause major shocks in the market, especially if the world is not completely ready to transition yet. If the US stopped supplying natural gas to the world, then that role would likely fall to Russia or the Middle East, the other major oil and gas producers. If they become primary suppliers to the rest of the world, it could upset US financial interests abroad. In general, capital requirements come with economic costs and fossil fuel-specific requirements have their own unique considerations.

However, we disagree with these assessments. While a green bubble and the end of fossil fuel production in the US could have major negative implications, it is improbable that simply changing capital requirements would cause such a radical shift. As noted in the "Low Impact" section, capital requirements tend to have little impact on how banks invest capital. Furthermore, this threat of a green bubble is a false dichotomy. Green energy and fossil fuels are not the only choices for investment; the banks have other options. The idea that all investments would shift from fossil fuels directly into green energy rapidly enough to create a green bubble and substantially curb fossil fuel use is naive. Instead, capital requirements will simply mitigate risk. When the financial risks of climate change manifest, the extra capital that financial regulators

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[54] Cathy Curtis, "While Green Investments are Underperforming, Investors Need to Remain Patient," *CNBC*, March 28, 2022, https://www.cnbc.com/2022/03/28/green-investing-is-underperforming-but-dont-count-it-out-just-yet.html.

[55] Marc Jones, "Central Bank Group BIS Warns of Green Asset Bubble Risk," *Reuters*, September 20, 2021, https://www.reuters.com/business/sustainable-business/global-markets-bis-esg-urgent-2021-09-20/.

[56] Damian Carrington, "Revealed: Oil Sector's 'Staggering' $3bn-a-day Profits for Last 50 Years," *The Guardian*, July 21, 2022, https://www.theguardian.com/environment/2022/jul/21/revealed-oil-sectors-staggering-profits-last-50-years.

require banks to hold will maintain stability. After all, the goal of financial regulators is to minimize risk and maintain stability, not slow climate change.

Implementation

Climate change and its transition-related consequences for the fossil fuel industry are unpredictable. Still, financial regulators must have a precise framework for quantifying capital requirements to avoid ambiguity and mitigate potential drawbacks. The transition and physical risks associated with climate change are especially salient for GSIBs. These banks present a "too big to fail" risk; therefore, regulators must have a heightened interest in preparing these institutions for macroprudential shocks.

Under the Basel III standardized approach, all corporate credit exposures automatically receive a risk weight of 100%, including fossil fuel assets.[57] Such "dirty" assets must be given a risk weight premium proportional to their exposure to transition and physical risks. There is already precedent for financial regulators to assign a higher weight to particularly insecure assets. In the aftermath of the housing crisis, high-volatility commercial real estate (HVCRE) exposures were assigned a risk weight of 150%.[58] The Federal Reserve proposed a rule change in 2016 that provides a baseline for potential climate-related risk weighting. The rule recognized that banks carrying certain physical commodities are exposed to unique credit, legal, and operational risks. For instance, banks with physical oil holdings "could face liability under various… environmental laws in the event of an ecologically damaging spill."[59] The proposed rule would assign risk weights for such commodities from 300 to 1,250 percent, depending on the asset's particular riskiness.[60] This proposed rule and the financial risks of "dirty" assets are similar in nature and purpose. We find it appropriate to weigh all "dirty" assets (beyond just commodities) within this similar 300 to 1,250 percent range. Climate change's transition and physical risks amounts to tens of trillions of dollars in potential losses, warranting this high risk weighting.[61]

The proposed weighting range is broad by design. Not all "dirty" assets carry the same transition and physical risks; therefore, risk adjustments should be made to reflect the idiosyncratic risk of certain assets. The extreme, upper end of this 300-1,250 percent range should only be reserved for the riskiest of assets. We suggest that regulators should adjust the

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[57] Francisco Covas and Barbora Stepankova, "Consistency in Risk Weights for Corporate Exposures Under the Standardized Approach," Bank Policy Institute (2022): 8, https://bpi.com/consistency-in-risk-weights-for-corporate-exposures-under-the-standardized-approach/.

[58] "Federal Register Vol. 78, No. 198: Regulatory Capital Rules," National Archives and Records Administration, October 11, 2013, https://www.govinfo.gov/content/pkg/FR-2013-10-11/pdf/2013-21653.pdf.

[59] Gelzinis, "Addressing Climate-Related Financial Risk," 15.

[60] "Federal Register Vol. 81, No. 190: Risk-Based Capital and Other Regulatory Requirements for Activities of Financial Holding Companies Related to Physical Commodities and Risk Based Capital Requirements for Merchant Banking Investments," National Archives and Records Administration, September 30, 2016, https://www.govinfo.gov/content/pkg/FR-2016-09-30/pdf/2016-23349.pdf.

[61] Caldecott et al., "Stranded Assets and Renewables," 6.

risk weights on fossil fuel-related loans with regard to three factors: (1) the revenue that the loan recipient derives from fossil fuels, (2) the duration of the exposure, and (3) the stated purpose of the loan.[62]

First, loans to firms who are more dependent on fossil fuels should carry higher risk weights. A company who only generates 10% of its income from fossil fuels versus one which derives more than 80% of its revenue from fossil fuel activities is inherently more exposed to climate change's transition risks because they are less diversified. Therefore, banks which loan to firms with more dependency on fossil fuels should conserve more capital in case of a default, and regulators should assign a higher risk weight on these assets.[63]

While the impacts associated with climate change are unpredictable, loans for a longer duration should also carry more risk. If a bank has multiple loans to the same oil and gas company, a loan for one or two years is unlikely to experience default due to energy regulations and transitions; however, a 20 or 30 year loan is more vulnerable. Consequently, loans with a longer duration of exposure should have an additional risk premium.[64]

Lastly, the nature/purpose of a loan should influence the precise risk weight regulators ascribe to a particular asset. A loan to a fossil fuel company is not inherently "dirty." Regulators should look at the intended use of funds in determining whether risk premiums apply. For instance, a bank should not conserve additional capital for a loan to BP's green energy initiatives, such as BP Solar.[65] Nonetheless, risk weights should still vary even for loans with the explicit purpose of fossil fuel financing. The transition away from fossil fuels will not be parallel for every commodity. Politicians are likely to target the most carbon intensive sources first, like coal, before transitioning away to other commodities that emit less, such as oil and gas.[66] Overall, regulators should assess the intended purpose of any financing project to determine whether or not it actually constitutes a "dirty" asset. From there, different risk weights should be prescribed proportional to its vulnerability to transition risk. These three factors (dependency of recipient, duration, and nature of loan) should differentiate the exact risk weights assigned to "dirty" assets within the aforementioned 300 to 1,250 percent window.

Conclusion

Climate change is an increasingly financial problem. It poses severe physical and transition risks to the soundness of all industries, and by extension, the financial system as a whole. Particularly, "dirty" assets are vulnerable to large losses as extreme weather events and policy changes become more likely. Currently, banks are not adjusting their balance sheets to adequately reflect these heightened risks in the wake of climate change. Capital requirements are

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[62] Gelzinis, "Addressing Climate-Related Financial Risk," 12.
[63] Gelzinis, "Addressing Climate-Related Financial Risk," 14.
[64] Gelzinis, "Addressing Climate-Related Financial Risk," 21.
[65] "BP Solar," BP, https://www.bp.com/en_us/united-states/home/what-we-do/gas-and-low-carbon-energy/bp-solar.html.
[66] Gelzinis, "Addressing Climate-Related Financial Risk," 12-13.

an effective tool in financial regulators' arsenal. These requirements can provide a robust financial cushion against unpredictable natural disasters and energy transitions. We therefore recommend that financial regulators require higher capital requirements for such "dirty" assets. Of course, this policy proposal does come with potential drawbacks; however, our proposed implementation adjusts for many of these concerns. Capital requirements for "dirty" assets should vary based on the loan recipients' dependency on fossil fuels, the duration of exposure, and the intended purpose of a loan. Additionally, we propose that these capital requirements are applied only to globally systemic important banks given their integral position in global markets. In this capacity, we think that our recommendation carefully balances the need to anticipate climate-related risks, while recognizing the need for precise implementation that does not cause unwarranted drawbacks. We are pleased that financial regulators are considering this position, and we look forward to any developments on this front.

Sincerely,

Paul Kamer, Eliza Holt, Jacob Hervey, and Giselle Wang

Bibliography

Anderson, Lauren, and Francisco Covas. "Climate Risk and Bank Capital Requirements." Bank Policy Institute (2021): 1-4. https://bpi.com/wp-content/uploads/2021/05/Climate-Risk-and-Bank-Capital-Requirements.pdf.

Armour, John, Luca Enriques, and Thom Wetzer. "Dark and Dirty Assets: Greening Climate-Driven Asset Partitioning." *Oxford Business Law Blog*. https://blogs.law.ox.ac.uk/business-law-blog/blog/2022/06/dark-and-dirty-assets-greening-climate-driven-asset-partitioning.

Bank of England. "Climate Change: What Are the Risks to Financial Stability." January 10, 2019. https://www.bankofengland.co.uk/knowledgebank/climate-change-what-are-the-risks-to-financial-stability.

Basel Committee on Banking Supervision. "Definition of Capital in Basel III." https://www.bis.org/fsi/fsisummaries/defcap_b3.pdf.

"Basel III: The Liquidity Coverage Ratio and Liquidity Risk Monitoring Tools." Basel Committee on Banking Supervision (2013): 1-75. https://www.bis.org/publ/bcbs238.pdf.

Beals, Rachel Koning. "'Pouring Gasoline on the Fire:' JPMorgan, Citi and Other U.S. Banks Lead Rise in Lending to Oil and Gas: Report." *MarketWatch*, April 2, 2022. https://www.marketwatch.com/story/pouring-gasoline-on-the-fire-jpmorgan-citi-and-other-u-s-banks-lead-rise-in-lending-to-oil-and-gas-report-11648642894.

Bertrand, Savannah. "Fact Sheet: Proposals to Reduce Fossil Fuel Subsidies." Environmental and Energy Study Institute. July 23, 2021. https://www.eesi.org/papers/view/fact-sheet-proposals-to-reduce-fossil-fuel-subsidies-2021.

Bousso, Ron. "BP Wipes up to $17.5 Billion From Assets with Bleaker Oil Outlook." *Reuters*, June 15, 2020. https://www.reuters.com/article/us-bp-writeoffs/bp-wipes-up-to-17-5-billion-from-assets-with-bleaker-oil-outlook-idUSKBN23M0QA.

BP. "BP Solar." https://www.bp.com/en_us/united-states/home/what-we-do/gas-and-low-carbon-energy/bp-solar.html.

Caldecott, Ben, Deger Saygin, Jasper Rigter, and Dolf Gielen. "Stranded Assets and Renewables: How the Energy Transition Affects the Value of Energy Reserves, Buildings, and Capital Stock." *International Renewable Energy Agency* (2017): 1-44.

Carrington, Damian. "Revealed: Oil Sector's 'Staggering' $3bn-a-day Profits for Last 50 Years." *The Guardian*, July 21, 2022. https://www.theguardian.com/environment/2022/jul/21/revealed-oil-sectors-staggering-profits-last-50-years.

Ceres. "New Ceres Report Explores Physical Risks of Climate Change Within the Banking Sector." September 8, 2021. https://www.ceres.org/news-center/press-releases/new-ceres-report-explores-physical-risks-climate-change-within-banking.

Chen, James. "Capital Requirements: Definition and Examples." https://www.investopedia.com/terms/c/capitalrequirement.asp.

Clarke, Ben, Friederike Otto, Rupert Stuart-Smith, and Luke Harrington. "Extreme Weather Impacts of Climate Change: An Attribution Perspective." *Environmental Research: Climate* 1, no. 1 (2022): 1-25. https://iopscience.iop.org/article/10.1088/2752-5295/ac6e7d.

Climate Central. "Sinking Tax Base: Land & Property at Risk from Rising Seas." September 8, 2022. https://assets.ctfassets.net/cxgxgstp8r5d/2KKeTjnqbFelWrZalnPeRR/9a28719038f3a1dddbdd2e8b78b8455b/CC_Sinking_Tax_Base_20220908a.pdf.

"Climate Change and Artificial Intelligence Seen as Risks to Investment Asset Allocation, Finds New Report by BNY Mellon Investment Management." *Bloomberg*, September 16, 2019. https://www.bloomberg.com/press-releases/2019-09-16/climate-change-and-artificial-intelligence-seen-as-risks-to-investment-asset-allocation-finds-new-report-by-bny-mellon-investm.

Cohen, Steve. "Preventing a Fossil Fuel Comeback in Congress." Columbia Climate School. October 24, 2022. https://news.climate.columbia.edu/2022/10/24/preventing-a-fossil-fuel-comeback-in-congress/.

Covas, Francisco, and Barbora Stepankova. "Consistency in Risk Weights for Corporate Exposures Under the Standardized Approach." Bank Policy Institute (2022): 1-22. https://bpi.com/consistency-in-risk-weights-for-corporate-exposures-under-the-standardized-approach/.

Curtis, Cathy. "While Green Investments are Underperforming, Investors Need to Remain Patient." *CNBC*, March 28, 2022. https://www.cnbc.com/2022/03/28/green-investing-is-underperforming-but-dont-count-it-out-just-yet.html.

EIA. "How Much Petroleum Does the United States Import and Export." https://www.eia.gov/tools/faqs/faq.php?id=727&t=6.

EIA. "Oil and Petroleum Products Explained: Oil Imports and Exports." https://www.eia.gov/energyexplained/oil-and-petroleum-products/imports-and-exports.php.

Federal Reserve. "Federal Reserve Supervision and Regulation Report - May 2020." https://www.federalreserve.gov/publications/2020-may-supervision-and-regulation-report-banking-system-conditions.htm.

Federal Reserve Bank of Minneapolis. "Capital Markets and Banking Regulation." September 18, 2020. https://www.minneapolisfed.org/speeches/2020/capital-markets-and-banking-regulation.

Federal Reserve Bank of St. Louis. "Weighted-Average Maturity for All Commercial and Industry Loans." https://fred.stlouisfed.org/series/EDANQ.

Ford, Greg, Julia Symon, Christian Nicol, and Laurent Dicale. "A Safer Transition for Fossil Banking: Quantifying the Additional Capital Needed to Reflect the Higher Risks of Fossil Fuel Exposures." *Finance Watch* (2022): 1-36. https://www.finance-watch.org/wp-content/uploads/2022/10/A-safer-transition-for-fossil-banking-Finance-Watch-report.pdf.

Gelfand, Alexander. "Why Divestment Doesn't Hurt 'Dirty' Companies." Stanford Business, October 27, 2021. https://www.gsb.stanford.edu/insights/why-divestment-doesnt-hurt-dirty-companies.

Gelzinis, Gregg. "Addressing Climate-Related Financial Risk Through Bank Capital Requirements." Center for American Progress (2021): 1-38.

GEP. "Russia-Ukraine War's Effects on the Oil and Gas Industry." July 5, 2022. https://www.gep.com/blog/mind/russia-ukraine-wars-effects-oil-and-gas-industry.

Glasgow Financial Alliance for Net Zero. "Our History." https://www.gfanzero.com/about/.

Hausfather, Zeke, and Pierre Friedlingstein. "Analysis: Global CO2 emissions from fossil fuels hit record high in 2022." *Carbon Brief*, November 11, 2022. https://www.carbonbrief.org/analysis-global-co2-emissions-from-fossil-fuels-hit-record-high-in-2022/.

Jessop, Simon. "World's Top Banks Pumped $742 Bln into Fossil Fuels in 2021 - Report." *Reuters*, March 30, 2022. https://www.reuters.com/business/sustainable-business/worlds-top-banks-pumped-742-bln-into-fossil-fuels-2021-report-2022-03-30/.

Jones, Marc. "Central Bank Group BIS Warns of Green Asset Bubble Risk." *Reuters*, September 20, 2021. https://www.reuters.com/business/sustainable-business/global-markets-bis-esg-urgent-2021-09-20/.

Lynas, Mark, Benjamin Z. Houlton, and Simon Perry. "Greater than 99% consensus on human-caused climate change in the peer-reviewed scientific literature." *Environmental Research Letters* 16, no. 11 (2021): 1-7.

Mallakpour, Iman, and Gabriele Villarini. "The changing nature of flooding across the central United States." *Nature Climate Change* 5, no. 3 (2015): 250-254.

Masterson, Victoria. "Renewables Were the World's Cheapest Source of Energy in 2020, New Report Shows." World Economic Forum. July 5, 2021. https://www.weforum.org/agenda/2021/07/renewables-cheapest-energy-source/.

National Aeronautics and Space Administration. "Evidence Climate Change is Real." https://climate.nasa.gov/evidence/.

National Archives and Records Administration. "Federal Register Vol. 78, No. 198: Regulatory Capital Rules." October 11, 2013. https://www.govinfo.gov/content/pkg/FR-2013-10-11/pdf/2013-21653.pdf.

National Archives and Records Administration. "Federal Register Vol. 81, No. 190: Risk-Based Capital and Other Regulatory Requirements for Activities of Financial Holding Companies Related to Physical Commodities and Risk Based Capital Requirements for Merchant Banking Investments." September 30, 2016. https://www.govinfo.gov/content/pkg/FR-2016-09-30/pdf/2016-23349.pdf.

National Oceanic and Atmospheric Administration. "Climate Change: Global Sea Level." April 19, 2022. https://www.climate.gov/news-features/understanding-climate/climate-change-global-sea-level.

National Oceanic and Atmospheric Administration. "Climate Change: Global Temperature Projections." March 6, 2012. https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature-projections.

Office of Energy Efficiency & Renewable Energy. "About the State Energy Program." https://www.energy.gov/eere/wipo/about-state-energy-program.

Ortiz-Bobea, Ariel, Toby R. Ault, Carlos M. Carrillo, Robert G. Chambers, and David B. Lobell. "Anthropogenic Climate Change Has Slowed Global Agricultural Productivity Growth." *Nature Climate Change* 11, no. 4 (2021): 306-312. https://doi.org/10.1038/s41558-021-01000-1.

Peoples, Steve. "In Intimate Moment, Biden Vows to 'End Fossil Fuel.'" *Associated Press*, September 6, 2019. https://apnews.com/article/9dfb1e4c381043bab6fd0fa6dece3974.

Perez, Mavin G. "'Swampy' Stench Haunts Florida's Orange Farms Devastated by Ian." *Bloomberg*, October 6, 2022. https://www.bloomberg.com/news/articles/2022-10-06/florida-orange-growers-lose-crops-to-hurricane-ian-wind-damage?leadSource=uverify%20wall.

Rainforest Action Network. "Banking on Climate Chaos: Fossil Fuel Financing Report 2022." https://www.ran.org/wp-content/uploads/2022/03/BOCC_2022_vSPREAD-1.pdf.

Rainforest Action Network. "Financing of Fossil Fuel Industry by Banks Worldwide 2016-2021." https://www.statista.com/statistics/1089798/global-financing-fossil-fuel-sector-bank/.

S&P Global. "A Bank Evaluates the Impact of Physical Climate Risk to Its Mortgages." https://www.spglobal.com/esg/case-studies/a-bank-evaluates-the-impact-of-physical-climate-risk-to-its-mortgages.

"Scientific Uncertainty." *Nature Climate Change* 9, no. 797 (2019): 1. https://doi.org/10.1038/s41558-019-0627-1.

Smith, Colby, and James Politi. "Democratic Senators Call for Tougher Capital Requirements for US Banks." *Financial Times*, March 2, 2021. https://www.ft.com/content/44792b80-c331-44e3-b02c-41a151f4cb6c.

"The Minneapolis Fed v. The Facts: The Struggle Continues." Bank Policy Institute (2020): 1-4. https://bpi.com/the-minneapolis-fed-v-the-facts-the-struggle-continues/.

The White House. "New Tools Needed to Assess Climate-Related Financial Risk." November 3, 2021. https://www.whitehouse.gov/cea/written-materials/2021/11/03/new-tools-needed-to-assess-climate-related-financial-risk-2/.

Tubb, Katie. "Biden's Radical, Anti-Fossil Fuel Energy Policy Costs Americans Dearly." The Heritage Foundation, June 28, 2022. https://www.heritage.org/energy-economics/commentary/bidens-radical-anti-fossil-fuel-energy-policy-costs-americans-dearly.

Tyson, Alec, Cary Funk, and Brian Kennedy. "Americans Largely Favor U.S. Taking Steps to Become Carbon Neutral by 2050." Pew Research Center. March 1, 2022. https://www.pewresearch.org/science/2022/03/01/americans-largely-favor-u-s-taking-steps-to-become-carbon-neutral-by-2050/.

Webb, Shelby. "Exxon Plans to Build World's Largest Carbon Capture Project in Baytown." *Houston Chronicle*, March 1, 2022. https://www.houstonchronicle.com/business/energy/article/Exxon-plans-to-build-nation-s-largest-carbon-16969014.php.

Wilkes, Tommy Reggiori. "Banks Undermine Their 'Net Zero' Pledges Through Lobbying - Report." *Reuters*, March 24, 2022. https://www.reuters.com/business/sustainable-business/banks-undermine-their-net-zero-pledges-through-lobbying-report-2022-03-25/.

Yale School of the Environment. "Extreme Weather Events Have Increased Significantly in the Last 20 Years." October 13, 2020. https://e360.yale.edu/digest/extreme-weather-events-have-increased-significantly-in-the-last-20-years.

Zhao, Chuang, Bing Liu, Shilong Piao, Xuhui Wang, David B. Lobell, Yao Huang, Mengtian Huang, Yitong Yao, Simona Bassu, and Philippe Ciais. "Temperature Increase Reduces Global Yields of Major Crops in Four Independent Estimates." *PNAS* 114, no. 35 (2017): 9326-9331. https://doi.org/10.1073/pnas.1701762114.